

Faster scans help. But whole-service capacity is limited by staffing, preparation and workflow bottlenecks.

The MRI capacity problem

MRI demand is ever increasing and waiting times are increasing despite increases in private providers spent [1]. Recent advances in AI acceleration promises shorter scan times [2]. **However, faster scanning does not automatically translate into increased capacity as MRI services are not limited by scan time alone.** Preparation, screening, setup, turnaround and staffing all shape capacity. Ultimately, faster scans may expose the next bottleneck, rather than solve the problem.

Aim

Using discrete event simulation, test whether faster MRI scans create real service capacity or simply move the bottleneck elsewhere.

- Compare simulated AI scan acceleration with staffing changes.
- Evaluate impact on waiting time, scanner utilisation, throughput and session overrun.

Simulation model

A discrete event simulation model [3] (Figure 1) was used to represent a standard outpatient MRI list, staffed by two radiographers and one clinical support worker.

What was modelled?

- A scheduled outpatient MRI list with mixture of examination.
- Patient arrival relative to appointment time.
- Patient preparation and final safety screening.
- Scanner setup, including positioning of patient and coil preparation.
- Image acquisition.
- Room turnaround before the next patient.
- Staff were modelled by role, so pathway steps could only proceed when an appropriately skilled staff member was available.

What was measured?

The model recorded patient-facing and operational measures including:

- Patient waiting time: time from arrival to scan start.
- Scanner utilisation: proportion of session time spent scanning.
- Staff workload : required staff time compared with available staff time.
- Patients completed: number of patients scanned during the session.
- End of session overrun: time required beyond the scheduled session end.

Scenarios Evaluated

The model was used to test whether faster scans created usable capacity under realistic outpatient MRI conditions.

Table 1. Simulated pathway scenarios comparing scan acceleration, staffing, lateness and protocol complexity.

Scenario	Model change	Test
Baseline	2 radiographers	What is expected performance under standard staffing?
AI acceleration	30% reduction in MSK acquisition time	Does faster acquisition improve pathway performance?
Reduced staffing	1 radiographer and 1 clinical support worker	How sensitive is capacity to radiographer availability?
30 min early arrival	Patients asked to arrive 30 minutes before appointment time	Does earlier arrival protect the list or increase patient waiting?
Block booking	Similar examination types grouped to reduce setup variation and coil changes	Does reducing protocol switching improve flow?
AI + Block booking	30% MSK acceleration combined with block booking	Does combining faster scans with workflow redesign create greater capacity gains?

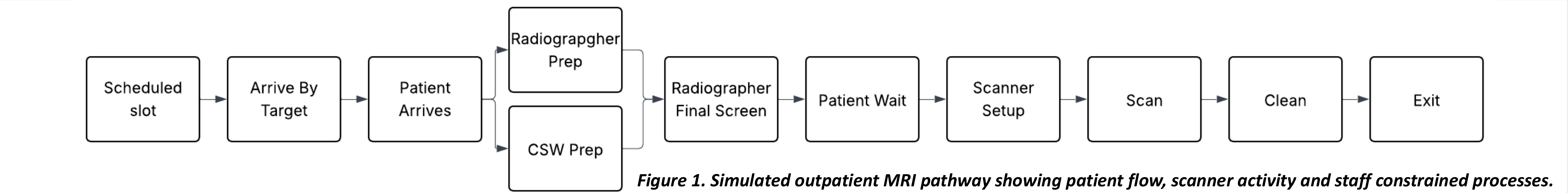


Figure 1. Simulated outpatient MRI pathway showing patient flow, scanner activity and staff constrained processes.

Results

Figure 2. Time plot of baseline configuration

Figure 2 is a Gantt-style chart showing the timeline of an MRI session. The x-axis represents time from 08:20 to 20:00. The y-axis lists examination types: MSK, Neuro, and Body. The chart includes scheduled slots (light blue), patient prep (green), scans (dark blue), and arrival/departure times (circles). It also shows radiographer lunch breaks (orange) and a planned finish time (red dashed line). A significant list overrun of 105 minutes is indicated at the end of the session.

Table 2. Effect of the different scenarios (table 1)

Scenario	Mean wait vs baseline	Overrun vs baseline	Scanner utilisation	Staff workload demand
Baseline	Reference	Reference	85.7%	80.5%
AI acceleration	↓ 4%	↓ 14%	82.0%	78.7%
Reduced staffing	↑ 93%	↑ 85%	82.8%	121.1% Radiographer 38.0% CSW
30 min early arrival	↑ 11%	↓ 12%	84.0%	79.9%
Block booking	↓ 13%	↑ 19%	87.4%	79.9%
AI + block booking	↓ 36%	↓ 34%	74.4%	73.3%

Scenario outputs were compared with baseline performance: **mean wait 72.0 min** and **list overrun 105.0 min**. AI acceleration gave modest gains, reducing mean wait by **4%** and overrun by **14%**. Reduced staffing had the greatest negative impact, increasing mean wait by **93%** and overrun by **85%**. Asking patients to arrive **30 min early** reduced overrun by **12%**, but increased mean wait by **11%**. Block booking reduced mean wait by **13%**, but increased overrun by **19%**. The best scenario was **AI + block booking**, reducing mean wait by **36%** and overrun by **34%**.

Conclusion

Faster scans helped, but they were not enough on their own. AI acceleration produced modest pathway gains, while reduced staffing substantially worsened waiting times and list overrun. The largest improvement came from combining faster acquisition with block booking, suggesting that MRI capacity is shaped by both technical innovation and workflow design

References

[1] Swann R et al. (2025) Clinical Radiology 91:107087, [10.1016/j.crad.2025.107087](#).

[2] Martin J et al. (2026) BMJ Open Quality 14:e003470, [10.1136/bmjog-2025-003470](#).

[3] Günal MM & Pidd M. (2010) Journal of Simulation 4.1 42-51, [10.1057/jos.2009.25](#)